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From Plasma Immersion Ion Implantation to Deposition: A Historical Perspective on Principles and Trends

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Plasma immersion techniques of surface modification are known under a myriad of names. The family of techniques reaches from pure plasma ion implantation modes, to implantation-deposition hybrid modes, to modes that are essentially pure plasma film deposition with substrate bias. In the most general sense, all plasma immersion techniques have in common that the surface of a substrate (or "target") is exposed to a plasma and that relatively high substrate bias is applied. The substrate bias is usually pulsed. In this talk, the roots of the immersion techniques are explored, some going back to the late 1800s, followed by a discussion of the groundbreaking works of Adler, Conrad, Mizuno, Chan, Collins, and many others in the 1980s. Plasma immersion techniques matured in the 1990s in theoretical understanding, scaling, and range of applications. First commercial facilities are now operational. While gas (often nitrogen) ion implantation dominated the early years, film-forming immersion techniques gain importance. In the 1980s and 90s we have seen exponential growth of the field but signs of a slowdown appear today. Nevertheless, plasma immersion techniques have found, and will keep, an important place among surface modification techniques.